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(71) Applicant(s)

SCA Mölnlycke AB

(Incorporated in Sweden)

S-405 03 Göteborg, Sweden

(72) Inventor(s)

Roy Hansson

(74) Agent and/or Address for Service

Boult Wade Tennant

27 Fumival Street, LONDON, EC4A 1PQ,

United Kingdom

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(56) Documents Cited

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(58) Field of Search

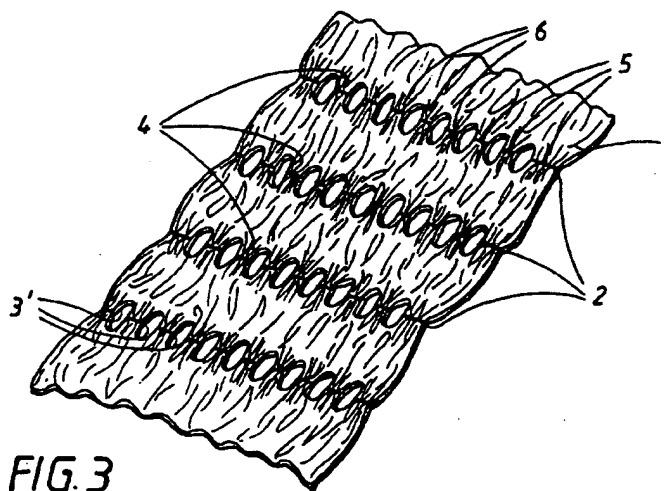
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(54) SURFACE MATERIAL WITH SLITS

(57) A liquid-permeable surface material for an absorbent article such as a diaper, an incontinence protector, a sanitary napkin, or the like, comprising a flexible, skin friendly material layer (1), and having at least one penetrating opening (3'). The opening (3') is formed by a slit (3) in the material layer (1) whereby the slit (3) has two longitudinal edges. Elongate elastic means (2) are pre-tensioned and arranged on both sides of the slit (3), substantially perpendicular to the edges of the slit (3), and act contractingly on the material on both sides of the slit (3) so that the edges of the slit (3) are pulled apart and the contracted material exhibits wrinkles (24) running substantially parallel to the slit (3). A method of manufacture, and absorbent articles including the surface material are also disclosed.



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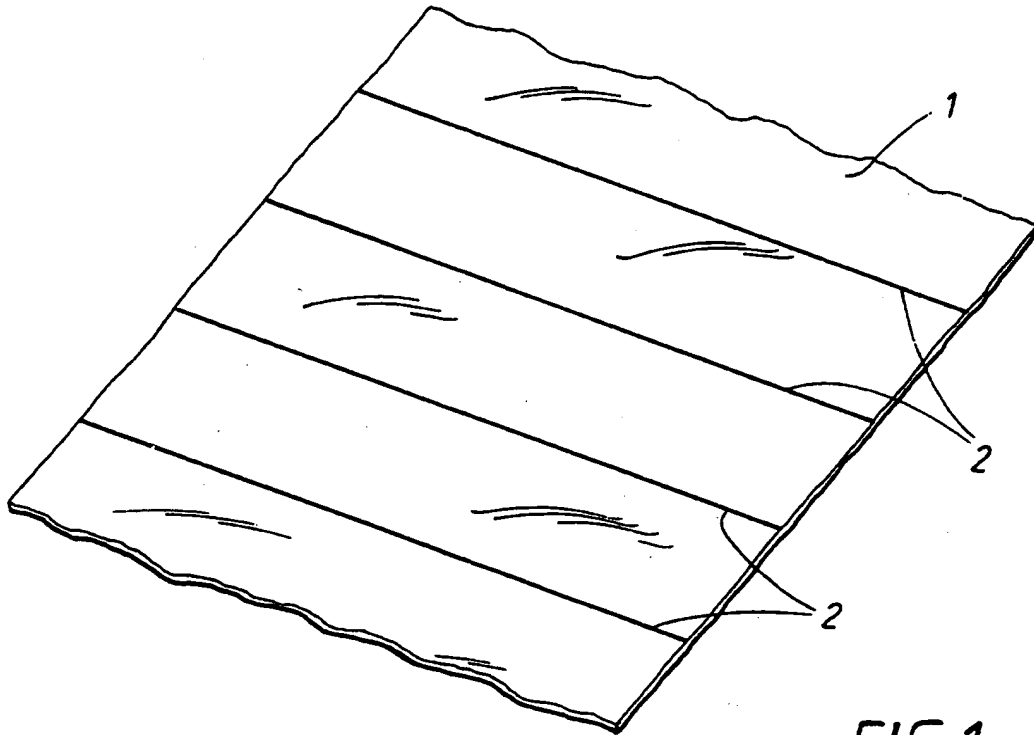


FIG. 1

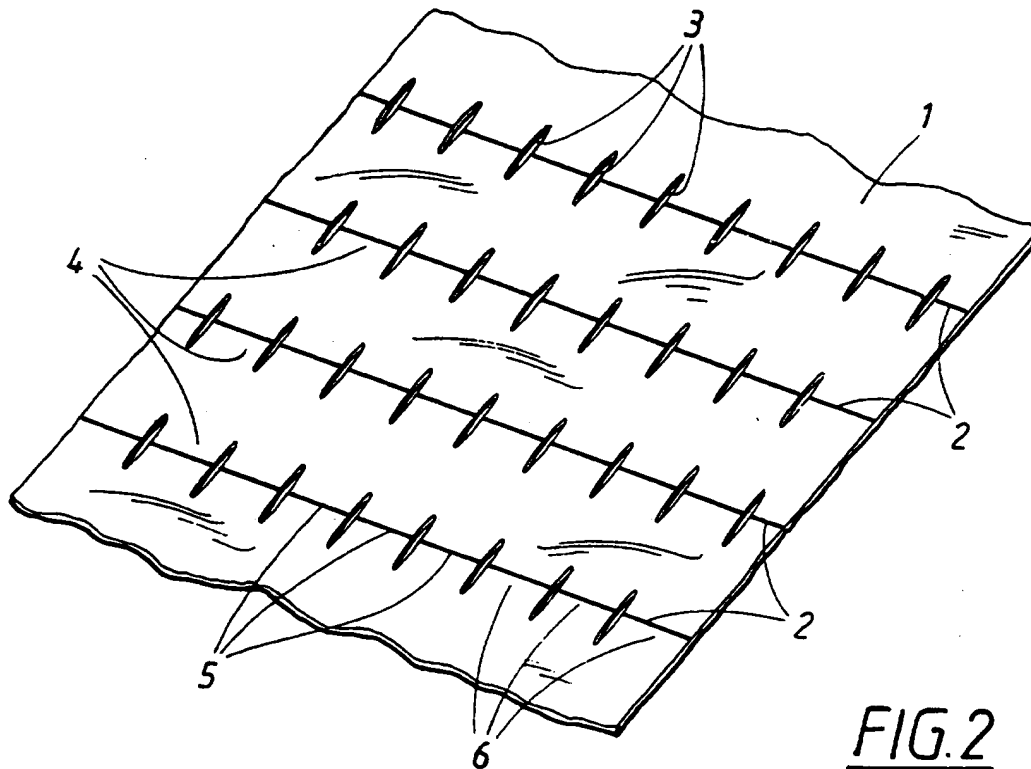


FIG. 2

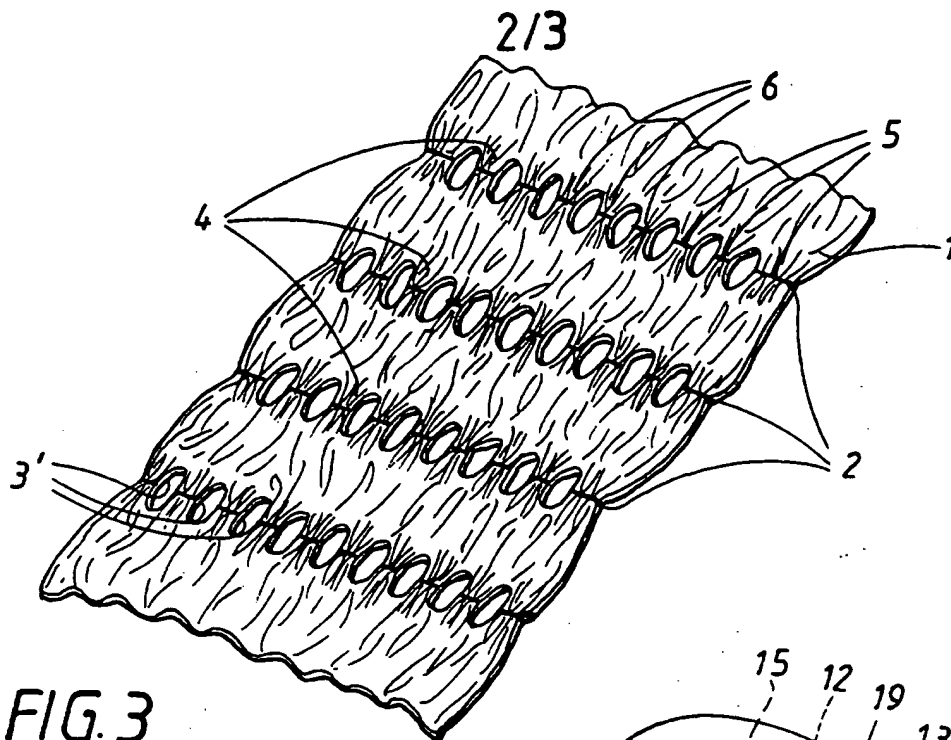


FIG. 3

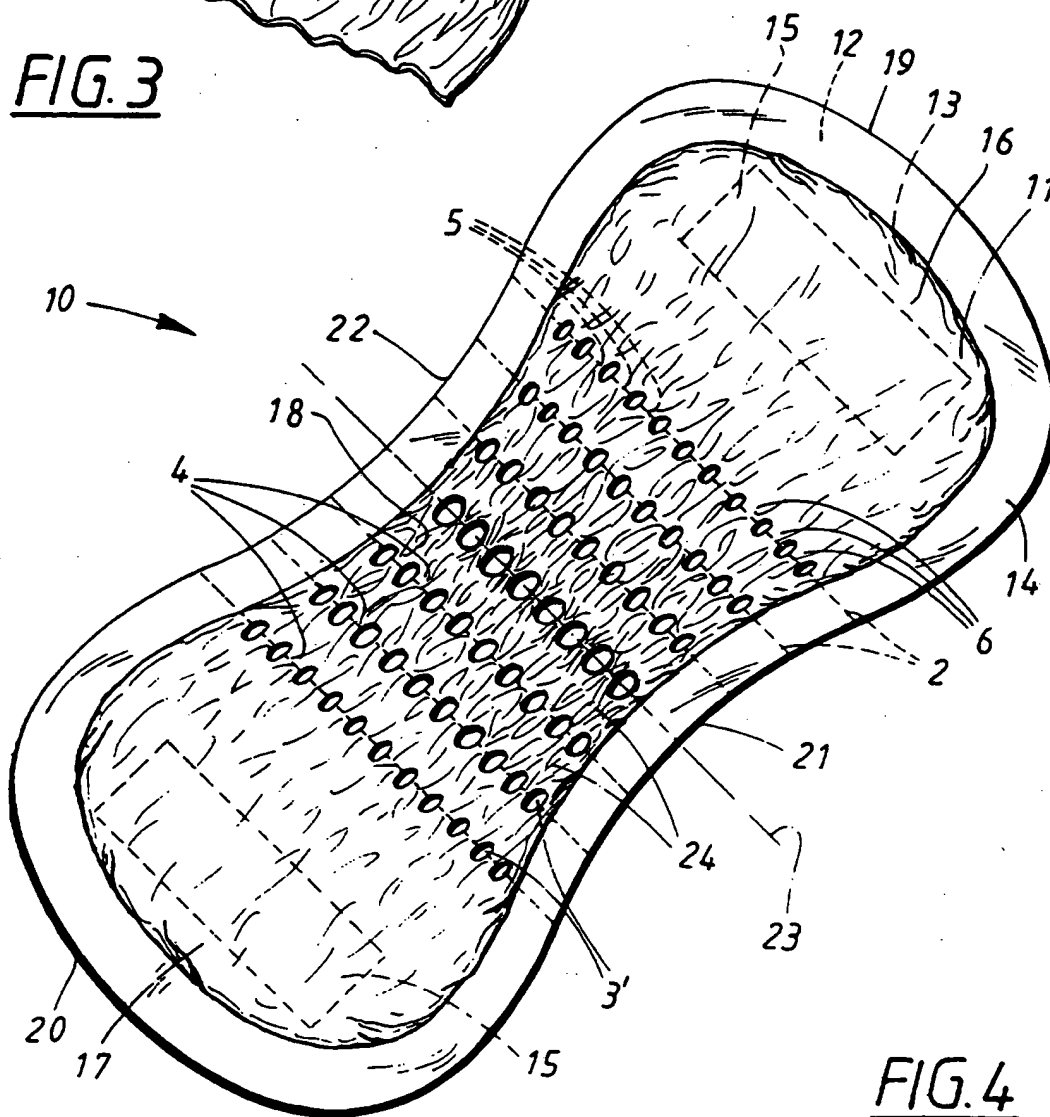


FIG. 4

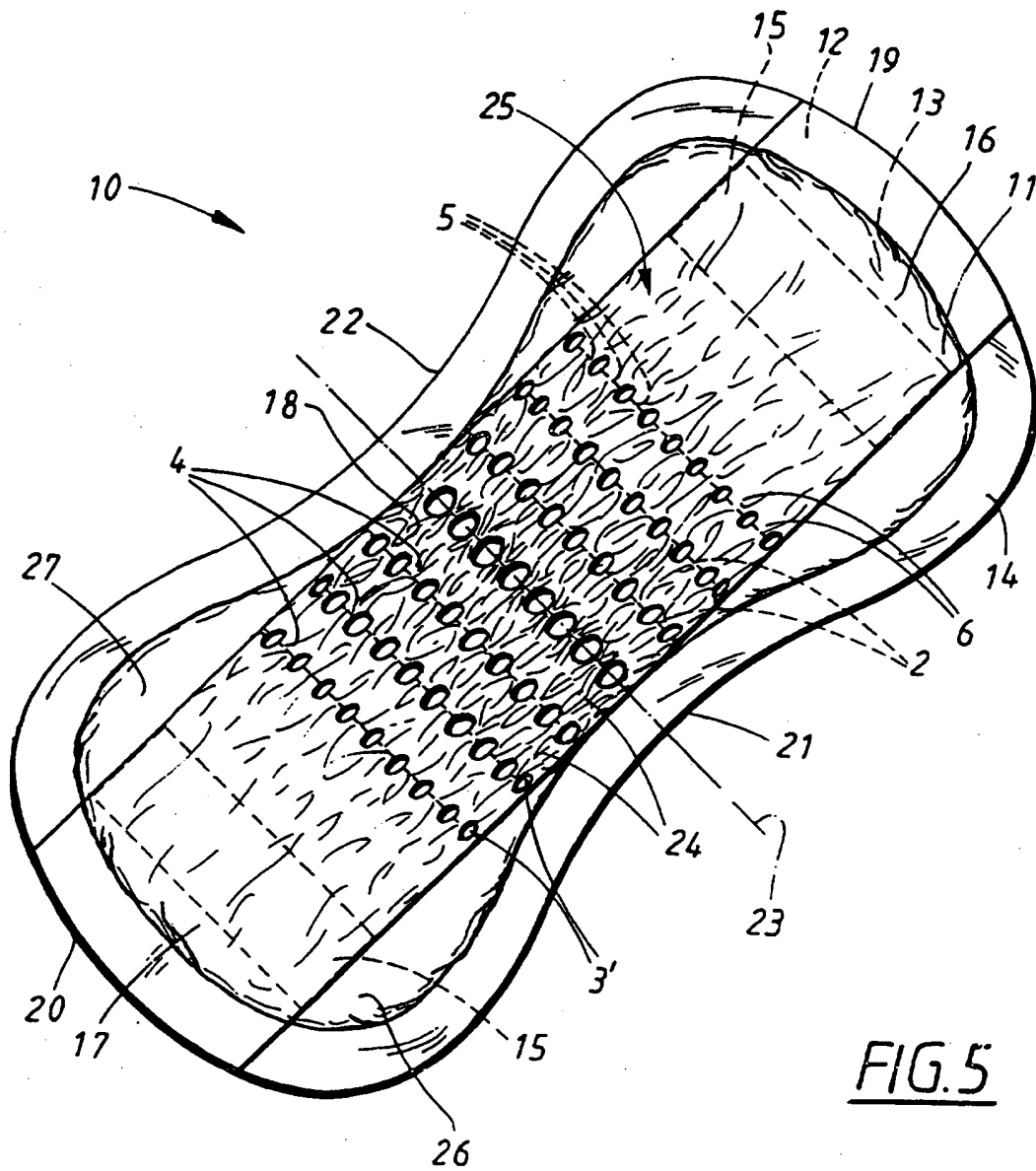


FIG. 5

5 **TITLE: A LIQUID PERMEABLE SURFACE MATERIAL FOR AN ABSORBENT
ARTICLE, AND A METHOD FOR ITS MANUFACTURE**

TECHNICAL AREA :

10 The invention relates to a liquid permeable surface
material for an absorbent article such as a diaper, an
incontinence protector, a sanitary napkin, or similar,
comprising a flexible, skin-friendly material layer, and
exhibiting at least one penetrating opening. The invention
also relates to a method of manufacturing the surface
15 material, and an article having the surface material.

BACKGROUND OF THE INVENTION:

20 With absorbent articles such as, primarily, incontinence
protectors for grown-up incontinent persons, there has long
been a considerable problem associated with creating a
surface layer which, during a very short period of time, is
capable of admitting a comparatively large volume of body
fluids to an absorption body arranged inside the surface
layer. For grown-up incontinent persons, the emptying of
25 the bladder is often both fast and sudden, resulting in a
considerable risk of discharged urine flowing on the outer
surface of the surface layer and running out over the edges
of the incontinence protector instead of penetrating the
surface layer and being absorbed by the absorption body.
30 Since grown-up incontinent persons often lead an active
life, with work and social interactions, it is certainly
very inconvenient not to be able to rely on the leakproof
safety of incontinence protectors. Additionally, soiling of
clothes, bedclothes and furniture results in unnecessary
35 extra work for the incontinent person, or for his or her
caretaker.

THE OBJECT OF THE INVENTION:

40 It is thus an object of the present invention to provide a
surface material of the type specified above, which

exhibits a rapid inlet of discharged body fluid and which substantially lowers the risk of the body fluid streaming out over the surface of the layer instead of passing down through the layer.

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SHORT DESCRIPTION OF THE INVENTION:

10 The surface material according to the invention is characterized primarily in that it has at least one opening which is formed by a slit in the material, wherein the slit has two longitudinal edges, and wherein elongated elastic means are pre-tensionally arranged on both sides of the slit, substantially perpendicularly to the edges of the slit, whereby the elastic means act contractingly on the material on both sides of the slit so that the edges of the
15 slit are pulled apart and the contracted material exhibits wrinkles extending substantially parallel to the slit.

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According to a preferred embodiment of the invention, the surface material has a plurality of openings formed by a row of slits arranged substantially parallel to each other. The elastic means are here arranged between the slits and extend along the row of slits substantially perpendicularly to the edges of the slits, whereby the material between the slits is wrinkled and the edges of the slits are pulled
25 apart.

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Further, it is possible, within the scope of the invention, to arrange two or more rows of slits with intermediate elastic means. In this manner, the length of the slits can vary between the different rows. It is further possible to vary the length of the slits within one single row.

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The mutual distance between the slits of two different rows can be different, as well as the mutual distance between the slits along one and the same row. It is also possible to vary the pre-tension of the elastic means between the

different rows as well as within the same row. Obviously, the distance between different rows can also vary across the surface of the layer. It is further possible, if desirable, to arrange the elastic means and the slits along one or more curve-shaped rows.

One method of manufacturing the surface material involves stretching a plurality of parallel elongated elastic means, placing and affixing the elastic means on a pliable, skin friendly material layer which is kept stretched in a planar condition during the affixating of the elastic means. The method is characterized primarily in that slits are made through the material layer whilst the material is kept stretched. Thereby, the slits are caused to extend substantially perpendicularly across the elastic means whereby the elastic means are severed at the slits whereafter the stretching of the material layer is discontinued and the elastic means are allowed to contract, whereby the material between the slits is wrinkled and the slits are widened through the pulling apart of the edges of the slits by the contracting force of the elastic means.

When the surface material is used as a liquid permeable top sheet on an absorbent article, such as an incontinence protector, a diaper, or a sanitary napkin, it is important that the layer is oriented in such a way that the elastic means run substantially perpendicularly across the product, whereby the wrinkles in the surface material formed during the contraction of the elastic means run in the longitudinal direction of the product. In this manner, the wrinkles act as liquid-dispersing channels which receive and transport body fluid out towards the end parts of the product, whereby the absorption capacity of the product can be better used. Furthermore, the wrinkles and the folds in the surface material act as barriers against liquid transport transversely across the product. Since absorbent

articles of the intended type practically without exception have a smaller dimension in the transverse direction than in the longitudinal direction, the risk of leakage is greatest at the longitudinal side edges. The use of the surface material according to the invention substantially reduces the risk of edge leakage, partly because the liquid is dispersed in the longitudinal direction of the product, and partly because liquid flow in the transverse direction is counteracted.

For an absorbent article having two end portions, and an intermediate crotch portion, it may be advantageous to arrange elastic means and openings in the liquid permeable cover layer substantially only within the area which is situated at the crotch portion of the article. The size and location of the crotch portion in the longitudinal direction of the article cannot be specified in absolute terms, since they may vary somewhat depending on different factors such as the shape of the article, the relevant category of use, how the product is applied inside the users underwear and the body shape of the user. By arranging openings only within the area which is intended to be the crotch portion of the article, the end parts of the article are left smooth, whereby the article is thinner within these portions and it is easier for a user to conceal the article under ordinary clothes.

It may also be advantageous to provide the area of the product which is intended to first be wetted by discharged body fluid with more and/or larger openings than the surrounding portions of the liquid permeable surface layer of the article. Further, the degree of wrinkling in the surface layer may conveniently be controlled by varying the tension in the elastic means and by varying the distance between the openings in the material layer. With increased tension in the elastic means and with an increasing

distance between the openings a larger degree of wrinkling is achieved. Since a heavy wrinkling is advantageous for the liquid receiving capacity of the article and for the liquid dispersion in the article, the formation of wrinkles should be most pronounced within the area of the article which is intended to be primarily wetted by the body fluid. This thus coincides with the area of the surface layer of the article which should be provided with the largest number of openings and/or the largest openings.

The invention will now be described more closely with reference to an embodiment which is shown in the attached drawings.

SHORT DESCRIPTION OF THE DRAWINGS:

Fig 1. of the drawings shows a material layer with affixed elastic means.

Fig. 2 shows the surface material of Fig. 1 after it has been slit.

Fig. 3 shows a completed surface material.

Fig. 4 shows how the surface material will look when it is applied to an incontinence protector.

Fig. 5 shows a further embodiment of an incontinence protection having a surface material according to the invention.

DESCRIPTION OF THE EMBODIMENTS:

The material layer 1 shown in Fig. 1, comprises a thin layer of skin friendly, flexible material. Suitable materials for this purpose are, for example, perforated or unperforated plastic films, textile or plastic nets, or non-woven textile materials, henceforth called non-woven

material. Furthermore, conventional textile materials, manufactured, for example, by weaving or knitting can, of course, be used if this is deemed suitable.

5 The material layer 1 is shown as a part of a continuous web of material. Elongate elastic means 2 are pre-tensioned and arranged transversely across the web of material. The elastic means 2 may, for example, consist of elastic threads, ribbons, or bands of elastic non-woven material, nettings, films or similar. In addition, elastic means consisting of two or more parallel elastic ribbons or threads are within the scope of the invention. The web of material is shown in a flat condition, i.e. with the elastic means stretched out. During the manufacturing of the surface material, the web of material is kept stretched out whilst applying the elastic means 2. The stretching out is achieved by some form of known stretching means, such as clamps, pins or the like. The stretching means are not shown in the drawings. The elastic means 2 can be affixed to the material layer 1 by gluing, or by welding with heat or ultrasonic sound. It is further conceivable that the elastic means are laminated between two layers which together form the web of material.

25 In Fig. 2, the web of material is provided with a plurality of longitudinal slits 3. The slits 3 are arranged in rows 4 transversely across the web of material 1 and are oriented so that each slit 3 is arranged perpendicularly over a transverse elastic means 2. The web of material 1 and the elastic means 2 are kept stretched out, so that the web of material is flat when the slits 3 are formed. The slits 3 can be formed in numerous different ways, for example by cutting using edge rollers, using ultrasonic sound, high pressure water jets, or by heating the material. When the web of material 1 is slit, the elastic

means are simultaneously cut, so that they are divided into a number of short sections 5 between the slits 3.

5 As can be seen from the drawing, the rows 4 of slits are displaced in relation to each other, so that the slits 3 of one row are positioned directly in front of the gaps of another row. Such an arrangement is, of course, not necessary; the slits of the different rows can be arranged in any suitable manner in relation to each other in order to provide the material with a desired appearance and a
10 desired function.

In Fig. 3 the stretching out of the web of material 1 has ceased, whereby the elastic means 2 have contracted. In
15 this way the portions of the material lying between the slits are wrinkled. The contraction of the elastic means 2 also results in the edges of the slits 3 being pulled apart so that the slits 3 are widened in the transverse direction of the material layer 1, and assume the shape of oval or,
20 more or less, rhombic openings 3'.

The incontinence protector 10 shown in Fig. 4 comprises a liquid-permeable surface layer 11 according to the invention, a liquid impermeable surface layer 12, and an
25 absorption body 13 enclosed between the surface layers 11, 12. The liquid-impermeable surface layer 12 may consist of a liquid-impermeable plastic film, a non-woven layer which has been coated with a liquid barrier material, or some other flexible material layer which resists liquid
30 penetration. Generally, it is an advantage if the barrier layer 12 has a certain degree of breathability, i.e. it allows the passage of water vapour. The two surface materials 11, 12 have a somewhat larger extension in the plane than the absorption body 13 and extend some distance
35 beyond the edges of the absorption body 13 along all of its periphery. The surface layers are mutually connected within

the protruding casing edge 14, for example by gluing or welding with heat or ultrasonic sound.

5 The absorption body 13 can be of any conventional kind. Examples of commonly used absorption materials are cellulose wadding, tissue layers, highly absorbing polymers, absorbing foam materials, absorbing non-woven materials and the like. Mixtures of materials as well as
10 absorption bodies constructed of layers of material of different kinds and with different properties are also known.

15 A fastening means 15 in the form of two areas of self-adhesive glue is arranged on the outside of the liquid impermeable envelope layer 12. The glue areas 15 are preferably covered before use by (not shown) removable protection layers of release agent treated paper, or plastic film. On the shown incontinence protector 10, the fastening means 15 consists of a transverse glue area at
20 each end of the protector. Numerous other glue patterns are, of course, conceivable, as well as other types of fastening means such as hook-and-loop surfaces, snap fasteners, girdles, special underpants or the like. An incontinence protector of the kind shown in Fig. 4 is
25 primarily intended to be used by persons having comparatively minor incontinence problems and is easily contained within a pair of ordinary underpants. The fastening means 15 then serves to keep the incontinence protector 10 in place in the underpants during use. The
30 fastening means 15 naturally has to be of such type that the incontinence protector can be removed from the underpants without damaging these.

35 The incontinence protector 10 is hour glass shaped, with wider end portions 16, 17 and a narrower crotch portion 18 located between the end portions 16, 17. The crotch portion

18 is the portion of the incontinence protector 10 which is intended, during use, to be placed in the user's crotch and serves as a receiving surface for the body fluid which is secreted to the incontinence protector 10. The incontinence protector further exhibits two transverse end edges 19, 20, and two longitudinal side edges 21, 22 running between the end edges 19, 20.

The liquid permeable surface layer 11 preferably consists of a liquid permeable material layer, such as a non-woven layer, or a perforated plastic film. Elongate elastic means 2 are affixed to the surface layer and run transversely over it between the side edges 21, 22 of the incontinence protector 10. Suitable elongate elastic means 2 are, as earlier mentioned, elastic ribbons or threads. The elastic means 2 are only arranged within the crotch portion 18 of the incontinence protector, while the end portions 16, 17 are without elastic means 2. In case a liquid impermeable layer has been used as surface layer, only the crotch portion 18 will be liquid permeable after slitting. The end portions 16, 17 will then function as barriers to leakage out of the front- and rear portions 16, 17 of the incontinence protector.

In the drawing, the elastic means 2 extend all the way out to the side edges 21, 22 of the incontinence protector. It may then be advantageous to treat the elastic means 2 so that they lose their elasticity within the area of the protruding casing edge 14. Such a treatment may, for example, be performed chemically or by using heat. It is, furthermore, possible to avoid an elastic contraction of the cover edge 14 by using a sealing glue along the edge 14 which allows the elastic means 2 to contract and creep inwards in the direction towards the absorption body 13, after being cut at the side edges 21, 22.

The surface layer 11 further exhibits a plurality of slits 3 arranged in transverse rows 4 which coincide with the extension of the elastic means 2. In this context, a slit 3 should be understood to mean a penetrating, longitudinal opening in the surface layer. A slit is typically a cut in the material, i.e. an opening which has only a length dimension but no width dimension, but also slot-shaped openings, i.e. openings having a certain, but in comparison to the length of the opening small, width dimension, are intended to be covered by the concept of a slit.

The slits 3 run perpendicularly across the elastic means 2 and divide them into several short pieces in the transverse direction of the incontinence protector. At the central part of the crotch portion 18, i.e. at the area of the crotch portion which is situated closest to a transverse center line 23 through the incontinence protector, the slits 3 are somewhat longer, preferably between 5-10 mm in length, than at parts of the crotch portion 18 located closest to the end portions 16, 17 of the incontinence protector 10 where the slits are between 2-7 mm in length. In addition, the centrally situated slits are arranged with a larger mutual spacing along the elastic means 2 than the slits closest to the end portions 16, 17. Furthermore, the elastic means 2 are affixed to the surface layer 11 with a larger degree of pre-tensioning within the area closest to the transverse center line 23 of the incontinence protector, whereby their contracting influence on the surface layer 11 is largest within this area.

Through the combination of different sizes of the slits 3, different spacing between the slits and different pre-tension of the elastic means 2, the surface layer will attain the appearance shown in Fig. 4. The openings 3' in the surface layer 11, which are formed when the elastic means 2 contract and the slits are widened, are larger at

the central part of the crotch portion 18 than at those parts of the crotch portion 18 which are located close to the end portions 16, 17. Furthermore, the wrinkling between the openings 3' in the surface layer 11 is larger within the central part of the crotch portion 18. This is partly due to the fact that the amount of material which can be wrinkled between the slits 3 is larger, partly because the contracting force is larger within this area.

This arrangement is particularly advantageous since the central part of the crotch portion 18 will receive the major part of the secreted body fluid during use. A large part of the body fluid can then quickly pass through the comparatively large openings 3' in the surface layer 11. Any part of the body fluid which does not have time to penetrate down through the surface layer 11 will instead be transported in the longitudinal channels 24 which are formed on the surface of the surface layer 11 through the wrinkling of the material between the openings 3'. The wrinkles in the surface material 11 thus act as a space in which fluid can be caught temporarily and be distributed in a controlled manner in the longitudinal direction of the incontinence protector 10.

Because the wrinkles, or channels, 24 run along the side edges 21, 22 of the incontinence protector, they furthermore act as barrier means which prevent the spreading of fluid in the transverse direction. Further, this condition contributes greatly to minimizing the risk of leakage of body fluid past the side edges 21, 22 of the incontinence protector.

It is advisable to avoid the use of transverse elastic means 2 at the end portions 16, 17 of the incontinence protector. One demand on incontinence protectors of this type is, namely, that they should be as discreet as

possible to wear and preferably be possible to conceal under ordinary clothes. Because the end portions 16, 17 do not have elastic means, the surface material 11 is not wrinkled, leaving the end portions 16, 17 flat and thinner than the crotch portion 18 of the incontinence protector.

As can be seen in Fig. 4, the size of the openings 3' and the degree of wrinkling decreases gradually from the transverse centre line 23 of the incontinence protector in the direction towards the end portions 16, 17. This is accomplished by a gradually decreasing slit length and decreasing tension of the elastic means 2. In Fig. 5 there is shown an incontinence protector 10 according to an alternative embodiment of the invention. The protector 10 is of the same general construction as the incontinence protector 10 shown in Fig. 4, wherefore the corresponding structural elements have been assigned the same numerals. The incontinence protector in Fig. 5 differs, however, from the incontinence protector of Fig. 4 in that the surface material according to the invention is only present in the shape of a material strip 25 between the two transverse edges 19, 20 of the incontinence protector. The material strip 25 extends along the full length of the incontinence protector 10 and has the same width as the width of the absorption body 13 at the transverse mid line 23 of the protector 10.

Laterally outside the material strip, pieces 26, 27 of another sheet of material are arranged, and are firmly attached to the material strip using any known method. Accordingly, these material pieces 26, 27, form together with the material strip 25 the liquid permeable surface layer 11 of the incontinence protector 10. The material pieces 26, 27, arranged on both sides of the material strip 25, extend past the edges of the absorption body 13 and are joined within the protruding parts 14 to corresponding

protruding parts 14 of the liquid-impermeable cover layer 12 of the incontinence protector 10.

5 The material pieces 26, 27 arranged along the side edges 21, 22 can be made from any suitable cover material. For example, different types of nonwoven material, as well as perforated or unperforated plastic films, nettings, laminates of plastic film and nonwoven, or similar can be used. Preferably, a material is chosen which is soft and
10 pleasant against the skin of the user and which allows ventilation between the skin and the material surface.

The material pieces 26, 27 may, furthermore, have a lower liquid permeability than the centrally arranged material
15 strip 25, whereby they act as liquid barrier means to prevent leakage of body fluid out of the absorption body 13 along the side edges 21, 22.

By applying the surface material according to the invention
20 as a material strip 25 only, the consumption of the comparatively expensive surface material can be minimized. Furthermore, it is possible to choose a material for the parts of the incontinence protection located along the side edges 21, 22 which is especially designed to present a soft
25 and pleasant border against the skin of the user. Furthermore, it is avoided that the elastic means 2 stretch out into and wrinkle the cover parts 14 which are located outside the absorption body 13 of the incontinence protector 10. The embodiment shown in Fig. 5 requires an
30 additional manufacturing step, during which the separate material pieces 26, 27 along the side edges are affixed to the central material strip 25.

According to an alternative embodiment, the central
35 material strip 25 is arranged on an undivided, continuous material layer which forms the material pieces 26, 27 along

the side edges 21, 22. Such a material layer thus extends beneath the material strip 25, between this and the absorption body 13 and outwardly on each side of the material strip 25, and forms the edge parts 14 connected to the liquid-impermeable cover layer 12. It is preferred that the material strip 25 is affixed on the additional material layer with the elastic means 2 pre-stretched, and that the slits 3 which divide the elastic means 2 are formed through both the material strip 25 and the additional material layer after the lamination has been performed.

A surface material according to the invention is particularly advantageous when it is used in connection with absorbent articles intended to be held by, and affixed inside, a pair of underpants. Usually, such products lack special edge leakage barriers at the side edges. The risk of edge leakage has therefore been rather high with earlier known such articles. With the surface material according to the invention, however, a liquid barrier effect is achieved through the wrinkling, at the same time as the fluid is dispersed in the longitudinal direction of the article, so that the absorbing capacity of the article is better put to use. The invention should, however, not be considered to be limited to such use, but the surface material is also suitable for use on childrens diapers, and different types of body-encompassing diapers for heavily incontinent grown-up persons.

Although the described embodiments show elastic means arranged in straight lines, it is of course possible to arrange elastic means along curving lines instead. The elastic means may be attached onto the surface of the surface material which is intended to be facing a user, but are preferably attached onto the surface which is facing away from the user. The risk of chafing and irritation of the user's skin is thus minimized.

5 CLAIMS

1. Liquid permeable surface material for an absorbent article such as a diaper, an incontinence protector, a sanitary napkin, or the like, comprising a flexible, skin friendly material layer (1), and having at least one penetrating opening (3), characterized in that the opening (3') is formed by a slit (3) in the material layer (1), whereby the slit (3) has two longitudinal edges, and that elongate elastic means (2) are pre-tensioned and arranged on both sides of the slit (3), substantially perpendicular to the edges of the slit (3), whereby the elastic means (2) act contractingly on the material on both sides of the slit (3) so that the edges of the slit (3) are pulled apart and the contracted material exhibits wrinkles (24) running substantially parallel to the slit (3).

2. Surface material according to claim 1, characterized in that it has a plurality of openings (3') formed by a row (4) of slits (3) arranged substantially parallel to each other, and that the elastic means (2) are arranged between the slits (3) and run along the row (4) of slits (3) substantially perpendicular to the edges of the slits (3), whereby the material between the slits (3) is wrinkled and the edges of the slits (3) are parted to form the openings (3').

3. Surface material according to claim 2, characterized in that it has two or more rows (4) of slits (3) with intermediate parts (5) of the elongate elastic means (2).

4. Surface material according to claim 2, characterized in that the slits (3) of two different rows (4) are of different lengths.

5. Surface material according to claim 3 or 4, characterized in that the mutual distance between the slits (3) of two different rows (4) is different in length.

5 6. Surface material according to any of the claims 2-5, characterized in that the distance between the slits (3) within the same row (4) varies.

10 7. Surface material according to any of the preceding claims, characterized in that the pre-tension of the elastic means (2) varies.

15 8. A method of manufacturing a surface material suitable for use in connection with an absorbent article, whereby a plurality of parallel elongate elastic means (2) are stretched out, applied and affixed to a flexible, skin friendly material layer (1) which is kept stretched to a planar condition during the application of the elastic means (2), characterized in that slits (3) are arranged through the material layer (1) whilst the material layer (1) is kept stretched out, which slits (3) are therewith arranged to substantially run perpendicularly across the elastic means (2), whereby the elastic means (2) are parted at the slits (3) whereafter the stretching of the material layer (1) is terminated and the parts (5) of the elastic means (2) between the slits (3) are allowed to contract whilst the material between the slits (3) is wrinkled and the slits (3) are widened through the pulling apart of the edges of the slits (3) by the contracting force of the elastic means (2).

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9. Absorbent article (10) such as an incontinence protector, a diaper or a sanitary napkin comprising an absorption body (13) enclosed between a liquid-permeable envelope layer (11) and a liquid-impermeable envelope layer (12), characterized in that the liquid-permeable envelope

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layer (11) has at least one penetrating opening (3') formed by a slit (3) in the envelope material whereby the slit (3) has two longitudinal edges, and that elongate elastic means (2) are pre-tensioned and affixed on both sides of the slit (3), substantially perpendicular to the edges of the slit, whereby the elastic means (2) act contractingly on the material on both sides of the slit (3) so that the edges of the slit are pulled apart and the contracted envelope material exhibits wrinkles (24) running substantially parallel to the slit (3).

10. Absorbent article according to claim 9, and further exhibiting two end portions (16, 17) and a intermediate crotch portion (18), characterized in that the liquid-permeable envelope layer (11) has openings (3') situated within the crotch portion (18) only.

11. Surface material as claimed in claim 1 substantially as hereinbefore described with reference to and as illustrated in Figure 3 of the accompanying drawings.

12. An absorbent article as claimed in claim 9 substantially as hereinbefore described with reference to and as illustrated in Figure 4 or 5 of the accompanying drawings.



Application No: GB 9703476.3
Claims searched: 1-12

Examiner: Jon Broughton
Date of search: 12 May 1997

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK CI (Ed.O): A5R (RPM, RPC)

Int CI (Ed.6): A61F 13/15

Other: Online: WPI

Documents considered to be relevant:

Category	Identity of document and relevant passage	Relevant to claims
X	GB 2284786 A (KIMBERLY-CLARK) see page 5 line 31 - page 6 line 18, page 15 line 29-36 and figures.	1-3 and 9.
A	GB 2279878 A (UNI-CHARM) see figures 9A and 9B and page 16 line 2-12.	
A	GB 821959 (PRITCHETT) see figures 1 and 2.	

X Document indicating lack of novelty or inventive step
Y Document indicating lack of inventive step if combined with one or more other documents of same category.

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P Document published on or after the declared priority date but before the filing date of this invention.

E Patent document published on or after, but with priority date earlier than, the filing date of this application.